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Subcommittee on Strategic Forces

COMMITTEE ON
ARMED SERVICES

UNITED STATES SENATE

HEARING TO RECEIVE TESTIMONY ON MISSILE DEFENSE STRATEGY, POLICIES, AND PROGRAMS IN REVIEW OF THE DEFENSE AUTHORIZATION FOR FISCAL YEAR 2023 AND THE FUTURE YEARS DEFENSE PROGRAM

Wednesday, May 18, 2022

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U.S. Senate
Subcommittee on Strategic Forces
Committee on Armed Services
Washington, D.C.

The subcommittee met, pursuant to notice, at 4:30 p.m. in Room SR-232A, Russell Senate Office Building, Hon. Angus King, chairman of the subcommittee, presiding.

Committee Members Present: King [presiding], Kelly, Fischer, Rounds, Sullivan, and Tuberville.

OPENING STATEMENT OF HON. ANGUS KING, U.S. SENATOR FROM MAINE

Senator King: -- budget submission for the Missile Defense Agency and missile defense policies in preparation for fiscal year 2023 National Defense Authorization Act. The Department of Defense has submitted to the Congress a Missile Defense Review and Nuclear Posture Review along with the National Defense Strategy.

While this overall document is classified and we await an unclassified version, and await, and await an unclassified version -- we would like to have that, by the way -- it continues the policy of defending the homeland and deterring attacks against the United States while assuring our allies, through a Regional Missile Defense Strategy. I would note it also continues the policy of reliance on our nuclear deterrent to protect against large and sophisticated attacks against our homeland from intercontinental ballistic missiles, air-launched ballistic missiles, or sea-launched ballistic missile threats from near-peer adversaries such as Russia and China.

Missile defense has two new aspects that we hope to examine in today's hearing. First and foremost is the defense against hypersonic missiles, which do not follow a ballistic trajectory. Second is the requirement to protect Guam against any threats that China might pose. This is a

daunting task that requires integration of missile defense systems from the Army, Navy, and Missile Defense Agency, and one I hope we will learn more about in today's hearing.

The President's budget submission for the Missile Defense Agency is $9.6 billion, a decrease from the fiscal year 2022 enacted level of $10.3 billion. I would like to know how the fiscal year 2023 budget request continues your effort for homeland and regional missile defense as well as defense against new threats such as hypersonic missiles.

Again, let me thank today's witnesses for agreeing to appear. After opening statements we will have rounds of 5-minute questions for the witnesses.

Senator Fischer?

STATEMENT OF HON. DEB FISCHER, U.S. SENATOR FROM NEBRASKA

Senator Fischer: Thank you, Mr. Chairman, and welcome to all of our witnesses today. We appreciate you appearing before us today and we look forward to hearing from each of you.

Overall, the budget request for fiscal year 2023 is a significant improvement over what the Administration proposed last year, and contains robust funding for the Next-Generation Interceptor program as well as for the defense of Guam.

While I am happy to see the Department finalize its plan for defending Guam and dedicate significant resources to do so, I cannot help but feel that this effort is already behind. The last two INDOPACOM commanders sought support for this project, and this subcommittee proposed to begin funding it 2 years ago, an effort that was ultimately rejected in favor of further study. In the time that has passed, the threat has only gotten worse.

Additionally, I continue to be concerned about the overall level of funding for missile defense proposed in this year's budget proposal. Compared to the fiscal year 2022 appropriation the Missile Defense Agency's budget would decline by over $700 million, a reduction of over 7 percent, at a time when threats are growing and the Department's

purchasing power is being eroded by the effects of inflation.

I look forward to hearing more from our witnesses about these issues and about how the fiscal year 2023 request would impact their mission.

Thank you, Mr. Chairman.

Senator King: Thank you. Our witnesses today are the Honorable Dr. David Honey, Deputy Under Secretary of Defense for Research and Engineering; Honorable John F. Plumb, Assistant Secretary of Defense for Space Policy; General Glen VanHerck, Commander, U.S. Northern Command and North American Aerospace Defense Command; Lieutenant General Daniel Karbler, Commanding General, U.S. Army Space and Missile Defense Command; and Vice Admiral Jon Hill, Director, Missile Defense Agency.

Secretary Honey, please.

STATEMENT OF THE HONORABLE DAVID HONEY, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

Mr. Honey: Chairman King, Ranking Member Fischer, and distinguished members of the Strategic Forces Subcommittee, thank you for the honor to appear before you today and to provide testimony on behalf of the Department of Defense for the Senate Armed Services Committee hearing on missile defense. I am pleased and appreciate the opportunity to discuss this important topic.

In a rapidly evolving threat environment, U.S. adversaries are developing more lethal weapons by advancing technology in areas such as ballistic, hypersonic, and cruises missiles that threaten the safety and security of the United States and our allies. In support of the National Defense Strategy priorities, the Department of Defense created the Office of the Under Secretary of Defense for Research and Engineering to set the strategy for technology and innovation while addressing the needs of the joint force. Directed energy, a defense-specific technology, is a key critical technology area we are developing to counter a wide variety of current and emerging threats with the goal of rapid response and engagement at the speed of light.

This is a joint effort that is being largely supported and carried out by the Office of the Undersecretary of

Defense for Research and Engineering, the Missile Defense Agency, the Air Force, the Army, and the Navy. The scope of the effort spans countering cruise missiles in the near term, hypersonic missiles in the near and medium term, and ballistic missiles in the long term.

To address the threat of adversaries' cruise missiles, a number of key technologies and capabilities crucial for countering cruise missiles will be demonstrated over the next 2 years. The OUSD(R&E) High Energy Laser Scaling Initiative, also known as HELSI, is funding industry to develop and deliver high-energy laser technology for cross-domain applications across the Department.

The Department is also developing high-power microwave weapons for a wide range of missions, including countering drones, cruise missiles, and hypersonic missiles. There is the Microwave Technology Testbed at MDA, the Remote Electromagnetic Disruption of Critical Advanced Threat, also known as REDCAT, at the Navy, and the Counter-Electronic High-Power Microwave Extended-Range Air Base Air Defense, CHIMERA, at the Air Force.

Lastly, countering hypersonic and ballistic missiles will require substantially more laser power. Therefore, under the HELSI effort, R&E will begin scaling laser powers in fiscal year 2023, and is examining opportunities to accelerate the scaling significantly. This combined with

improved beam control systems will allow capabilities against hypersonic and ballistic missiles to be developed by the services and Missile Defense Agency.

Chairman King, Ranking Member Fischer, members of the sbcommittee, the R&E is committed to setting the technology and innovation strategy to advance defense-specific technologies, such as directed energy, and deliver these critical capabilities to the warfighter. We will continue to support these joint efforts to increase readiness as well as the capability and capacity of fielded homeland and regional missile defense systems while investing in advanced technology that offer new ways to counter a diverse set of threats.

Thank you again for the invitation to testify and I look forward to answering the committee's questions. Thank you.

[The prepared statement of Mr. Honey follows:]

Senator King: Dr. Plumb?

STATEMENT OF THE HONORABLE JOHN PLUMB, ASSISTANT SECRETARY OF DEFENSE FOR SPACE POLICY

Mr. Plumb: Chairman King, Ranking Member Fischer, and members of the committee, thank you for inviting me again to testify today, today on missile defense strategy policies and programs.

The missile threat continues to evolve, and as Secretary Austin has stated, China is the Department's pacing threat. China has advanced its missile capabilities over the last 20 years to counter the U.S. and the Indo-Pacific and to intimidate and threaten its neighbors, including Taiwan.

Russia is developing, testing, and deploying new missile that pose challenges for U.S. missile warning, and Ukraine, Russia has launched well over 1,500 missiles as part of an unprovoked campaign that has caused the deaths of thousands.

North Korea continues to improve, expand, and diversify its missile capabilities, posing an increasing risk to the U.S. homeland, our forces, allies, and partners. North Korea has accelerated its missile testing in recent months, including the launch of long-range missiles.

And Iran maintains a large and growing inventory of regional missiles as well as uncrewed aerial system, UAS, which it uses both directly and via proxy groups to strike

its neighbors. Iran's nascent space program could shorten its pathway to a future long-range missile capability.

So in light of these threats, the Department reassessed its missile defense policy, including inputs from interagency stakeholders, allies, and partners, in the 2022 Missile Defense Review, the MDR. As you have noted, the classified MDR was provided to Congress in late March.

Missile defenses contribute to deterrence in many ways. They provide resilience, they complicate adversary attack plans and reduce adversary confidence, they raise the threshold for potential conflict, they help assure our allies and partners, and they limit damage from missile attacks, which in turn provides additional decision space for senior leadership.

The Department's top priority is to defend the homeland and deter attacks against the United States. The President's budget request includes significant investments in homeland missile defense, including $2.8 billion to develop the Next-Generation Interceptor and for the service life extension of our GBIs; $4.7 billion to fund the transition to a resilient missile warning and missile track satellite architecture -- and it is important to note that this is not part of the MDA budget. This is $4.7 billion for the Space Force -- $278 million for new, over-the-horizon radars to enhance our ability to detect cruise

missile attacks on the homeland; and $892 mission to field missile defense capabilities to augment the THAAD battery on Guam. Guam, like all U.S. territories, is unequivocally part of the U.S. homeland, and a missile strike against Guam is a direct attack against the United States.

For regional defense the Department is also strengthening our missile defenses to counter regional threats that include hypersonic threats. The President's budget request invests heavily in regional ballistic cruise and hypersonic missile defenses, including $3 billion for Army ballistic and cruise missile defense programs, including the procurement of 252 more Patriot Interceptors; $2 billion for Aegis BMD, including procurement of 57 more SM3 missiles; $335 million for THAAD development, procurement, and testing; $1.3 billion for hypersonic missile tracking and defense; and $825 million for counter-UAS solutions.

The sobering reality of the tragic events in Ukraine, in which Russia has used and continues to use a broad array of missiles to attack, and in my opinion terrorize, civilian populations highlights the extent to which our adversaries are prepared to use missiles in a conflict. Missile defenses are critical for defending the U.S. homeland and for defending our deployed forces and our allies and partners. The Department and the Administration remain

committed to improving them.

I look forward to working with the Congress to advance this shared goal, and I thank you and look forward to your questions.

[The prepared statement of Mr. Plumb follows:]

Senator King: General VanHerck?

STATEMENT OF GENERAL GLEN VANHERCK, COMMANDER, UNITED STATES NORTHERN COMMAND AND NORTH AMERICAN AEROSPACE DEFENSE COMMAND

General VanHerck: Chairman King, Ranking Member Fischer, distinguished members of the subcommittee, it is my honor to represent the men and women of the United States Northern Command and North American Aerospace Defense Command as we defend Canada and the United States. I appreciate the opportunity to testify alongside Dr. Honey, Dr. Plumb, Vice Admiral Hill, and Lieutenant General Karbler.

NORTHCOM and NORAD face the most dynamic and strategically complex environment in our respective histories. Strategy competitors have openly declared their intent to hold our homeland at risk in an effort to advance their own interests and limit our options and ability to respond.

North Korea continues to test nuclear-capable ballistic missiles with increased range and lethality, while Russia and China have fielded and continue to invest heavily in advanced long-range cruise missiles, hypersonic missiles, and delivery platforms. And as we have seen throughout Russia's unprovoked and irresponsible invasion of Ukraine, Russia has fielded large numbers of long-range cruise missiles, including hypersonic missiles, that can cause

enormous damage to infrastructure, create strategic effects with conventional warheads.

These conventional precision strike capabilities and advanced delivery platforms are designed specifically to hold critical infrastructure in the homeland at risk below the nuclear threshold, in order to disrupt and delay our ability to project power globally while attempting to undermine our will to intervene in a regional crisis overseas.

In my view, missile defense of the homeland starts with a strategic deterrent, to include the options and survivability provided by a reliable and effective nuclear triad. But as I testified before the full committee, I am concerned that deterrence by cost imposition does not adequately account for the conventional capabilities our competitors have already fielded. This overreliance increases the risk of miscalculation and escalation because it limits our national leaders' options in crisis and conflict.

To account for the full range of our competitors' nuclear and conventional capabilities, it is necessary to balance deterrence by cost imposition with deterrence by denial, an integrated deterrence that employs all elements of national influence. This integrated approach leverages both military and non-military capabilities in order to

provide our leaders with a wide range of timely deterrence options.

To be clear, we must continually demonstrate to potential aggressors that an attack on the homeland will result in failure. We do that by demonstrating reliable and effective capabilities that cause potential adversaries to doubt their chances of an effective attack on the homeland. This is why I continue to support Vice Admiral Hill's plan to field the Next-Generation Interceptor by 2028, or sooner if possible.

Deterrence by denial also includes demonstrating homeland readiness, responsiveness, and resiliency along a range of kinetic and non-kinetic capabilities to defend the homeland. NORTHCOM's support to civil authorities and our security cooperation relationships with allies and partners are critical to integrated deterrence, as is NORAD's mission to provide threat warning and attack assessment and defend the approaches to North America. In this strategy environment, we cannot wait for our competitors to act. It is vital that we get ahead of our competitors' decision-making and provide our national leaders with timely and informed options needed to achieve favorable outcomes.

With that necessity in mind, NORTHCOM and NORAD are focused on four strategic principles in our homeland defense design, starting with all-domain awareness, from under sea,

on orbit, and everything in between, to include the cyber domain. Simply put, we have to be able to see the threats in order to deter and, if required, defeat them.

I want to thank the subcommittee for your support of the over-the-horizon radars on my fiscal year 2022 unfunded priorities list. Over-the-horizon radar will significantly improve my ability to detect and track threats in the air, maritime, and space domains. I ask for your continued support in authorizing the funding requested for over-the-horizon radar in the fiscal year 2023 President's budget.

All-domain awareness is required to achieve information dominance, which is the use of advanced capabilities like machine learning and artificial intelligence to quickly analyze, process, and deliver data to decision-makers at the speed of relevance. By doing so, we will increase senior leader decision space and enable decision superiority over competitors.

Finally, today's problems are global and all-domain, and they demand globally integrated strategies, plans, and actions. Missile threats to the homeland inherently originate beyond my area of responsibility, so it is vital that we have the ability to detect potential threats and share data rapidly between commands, agencies, allies, and partners around the world. These strategic priorities are vital elements of our ability to execute a layered defense

in the execution of the National Defense Strategy and integrated deterrence.

I will end by thanking the committee for all you have done to support our soldiers, sailors, airmen, marines, and guardians as they defend the homeland. Thanks for the opportunity to appear and I look forward to your questions.

[The prepared statement of General VanHerck follows:]

Senator King: Thank you, General.

And General Karbler?

STATEMENT OF LIEUTENANT GENERAL DANIEL KARBLER, COMMANDING GENERAL, UNITED STATES ARMY SPACE AND MISSILE DEFENSE COMMAND

General Karbler: Chairman King, Ranking Member Fischer, distinguished members of the subcommittee, I am honored to again testify before you representing an incredible People First organization of more than 3,000 soldiers and civilians across 10 time zones and 22 locations. These amazing professionals provide space, high-altitude, and missile defense forces and capabilities to Army and joint warfighters. Let me express my sincere appreciation for your continued support of our people and their families.

My role remains unchanged from previous testimony. I serve as the Commander of the Joint Functional Component Command for Integrated Missile Defense. As the Army's proponent for Air and Missile Defense, or AMD, I provide U.S. Northern Command, the soldiers who stand ready to defend our nation from intercontinental ballistic missile attacks. I serve as the Army's Service Component Commander to both U.S. Strategic Command and U.S. Space Command, and I serve as the Army's AMD enterprise integrator.

We have witnessed significant changes over the past year, to include the largest employment of offensive missile systems in Europe since World War II in Russia's invasion of

Ukraine. Like Russia, other potential adversaries across the globe are developing, fielding, and normalizing the use of increasingly diverse, robust, and lethal offensive missile systems in an attempt to gain coercive power and strategic advantage over the United States and our allies and partners.

It has never been more imperative that we strengthen our capabilities to deny our adversaries the benefits of using these weapons. We will accomplish this through continued investment and sustainment of combat-ready, integrated, and lethal AMD forces. Space capabilities, combined with our allies and partners, will also prove essential in ensuring our nation's security.

To address the challenges of the ever-changing landscape we continue to implement new ways of accomplishing our mission and enhancing our capabilities. To briefly outline a few enhancements, our space and missile defense soldiers and civilians have completed an upgrade to our Joint Tactical Ground Stations at our four global theater missile warning company locations. These upgrades include our missile warning, missile defense cueing, and battlespace characterization in support of multidomain operations.

We have relocated two European-based U.S. Patriot batteries to Poland and one to Slovakia. This defense relocation reinforces our nation's commitment to Article 5

and proactively counters any potential threats to U.S. and allied forces in NATO's eastern region.

During a joint March 2022 exercise, an air defense battalion under the European-based 10th Army Air and Missile Defense Command successfully deployed four Maneuver-Short Range Air Defense Stryker-based platforms throughout NATO's eastern region, a move of over 1,500 miles which culminated in a successful live fire in Estonia. Support to testing and exercises remains a priority.

Earlier this year, Air Defense Artillery soldiers participated in THAAD Flight Test-21, where two Patriot Advanced Capability-3 Missile Segment Enhanced interceptors were integrated with THAAD software to successfully intercept two short-range ballistic missiles. This integration enables earlier interceptor launch and results in increased defended area or battlespace.

Our soldiers also recently completed Phase 1 of the Integrated Air and Missile Defense Battle Command System initial operational test and evaluation, in full support of the Army's number one AMD modernization effort.

Let me close by again highlighting our most important asset, our people, who remain committed to accomplishing our no-fail national security mission. Despite the challenges of the COVID-19 pandemic, our professionals continue to provide space and missile defense capabilities to support

combatant commanders. It is our people who make us strong. It is our people who make winning possible. I consider it an honor and a privilege to lead and serve alongside them and request the continued support of Congress to sustain our ability to recruit, develop, retain, and resource such a highly qualified and mission-ready team. When you put people first, winning happens.

I look forward to addressing your questions. Thank you.

[The prepared statement of General Karbler follows:]

Senator King: Thank you, General.

Admiral Hill?

STATEMENT OF VICE ADMIRAL JON HILL, DIRECTOR, MISSILE DEFENSE AGENCY

Admiral Hill: Good afternoon, Chairman King, Ranking Member Fischer, distinguished members of the subcommittee. It is a great honor to be here with some incredible key partnerships here to testify before you today.

I would like to first start by recognizing and thanking those who operate from abroad and here at home, operating the Integrated Missile Defense System, and then, of course, my Missile Defense Agency team, comprised of military, civilian, and contractor workforces that ensure that the warfighters can operate those systems.

Our fiscal year 2023 budget was mentioned as $9.6 billion to continue the mission of protecting the homeland, our forward-deployed forces, our friends, and allies.

A little bit back on the threat. Everyone has mentioned it. I want to put a finer point on it. When you think about advanced ballistic missiles, long-range cruise missiles, hypersonic missiles, what that really means, down at the warfighter level, is heavy maneuver, large numbers, at high speed, with 360-degree attack. That is a challenge.

So rather than walking through all of the elements of the Integrated Missile Defense System that we have deployed globally and operated by our services, I want to focus in on what I see as the three top priorities for President's

budget 2023.

Priority one is the no-fail mission of defend the homeland against ballistic attacks from the rogue nations. I want to thank Congress for the great support on the service life extension program. We are making great progress. We are on track, ahead of schedule. We have got the first round that we refurbished back in the hole now, number two is inbound, and rounds three, four, and five are being processed now. That is going to extend the reliability of our in-service fleet --

Senator King: I would prefer you not use the term "inbound" in this room. It makes me a little nervous.

[Laughter.]

Admiral Hill: Yes, sir. I will scratch that from the script.

Then I would like to switch on over to Next-Generation Interceptor. As was mentioned earlier, we are at light speed working very closely with General VanHerck and his team to ensure that the two contractors that we put in place last year about this time, March of 2021, are tracking to get to first in placement around the 2028 time frame. Right now both are performing so well that they are anticipating, and our team believes that we are tracking towards 2027. So that is incredible. That means flight testing earlier. That means ground testing earlier. That means we have a

better sense of where we are as we move forward to upgrade the numbers of interceptors and the capability that we will be bringing forward.

Priority two -- and the reason it is priority two is not just because it is a territory with U.S. citizens living on it. It will be one of the most difficult things we do as an agency, and that is the defense of Guam. We have a current architecture with a ship stationed up forward and we have a THAAD battery on the island. We have a clear set of operational requirements from INDOPACOM. We finalized the architecture in President's budget 2023. The Department did provide funds in fiscal year 2022 to accelerate, and then Congress added a plus-up for us to do that.

Our plan is to leverage mature systems to expand so that we have emerging capabilities tied in, and I think the most important thing that we will bring to the table is a single command and control structure, critically important for the Pacific Defense Initiative. So we are staying very close to INDOPACOM as we move through this development.

Priority three, really driven by the threat, and that is the hypersonic missile defense that has been mentioned by everybody. We are leveraging our existing sensors today to get indications and warnings, so we are not starting at zero. Our command and control battle management deployed globally has the ability to pull in the space assets that

are available, the land-based assets, the sea-based assets, to get us track on hypersonics when they fly through the field of view. Our command and control battle management system, C2BMC, is running a prototype today that provides indications and warning to INDOPACOM.

Where we are going in fiscal year 2023 is we will have our first two Hypersonic and Ballistic Tracking Space Sensors, HBTSS, in space, operating in an inclination to where we can collect data from testing we do in the INDOPACOM region. We are going to get fire control data where we can leverage our weapons.

What we have deployed today for hypersonic defense, with the sea base, is the sea-based terminal capability. I mentioned that already. That has been deployed for a while. We are on Increment 2 of that capability and moving out towards Increment 3. And when I say that, that means we are expanding the threat set to take on a larger number of those hypersonic threats.

Where we need to go is away from the terminal area. You have to defend there but it is the most difficult place to engage because you really do not know where a terminal is going to be, because it is maneuvering and it is high speed. So we are moving to get to a layered defense capability, and in the President's budget 2023 we are going forward with the Glide Phase Interceptor. We have three companies on board

now, and we will be down-selecting to two later this year.

So Chairman King, Ranking Member Fischer, members of the subcommittee, MDA continues to increase readiness, resiliency, and cybersecurity and the capability and capacity of homeland and regional defenses while investing in advanced technology. We are committed to attracting and building a strong, talented, future workforce, and our capabilities-based approach and unique acquisition authorities enable MDA to deliver by, through, and with the services to the combatant commands to meet their requirements.

I appreciate your continued support for the Missile Defense Agency, the people, and the missile defense mission. I look forward to answering your questions. Thank you.

[The prepared statement of Admiral Hill follows:]

Senator King: Thank you, Admiral, and thanks to all of you for your extraordinary service and work.

I want to start with some budget questions, and I do not think we are seeing the full picture when we talk about the Missile Defense Agency budget. Dr. Plumb, are there not other missile-related expenditures in other parts of the budget? I think you touched on this. I want apples to apples from last year to this year on the whole missile defense enterprise.

Mr. Plumb: Yes, sir. I do not think I can give you the specific numbers. I will say, at least for the $4.7 billion for the transition, the first piece of funding to transition to a robust, proliferated, low-earth orbit missile warning and missile track architecture, including an architecture that can observe hypersonic weapons, that is $4.7 billion more than it was in the budget the previous year. That is a new thing.

My colleague here, Secretary Honey, was just talking about the directed energy funding. That funding is no longer part of MDA's budget. At least most of it is now with R&E. So there is a bucket of money there.

Senator King: It would be helpful for me, Dr. Honey, for the record, not right now, but for the record of this hearing if you could give us a sort of apples to apples with all the pieces of the budget last year and this year. Can

you supply that?

Mr. Honey: Yes. We will take that for the record, sir.

Senator King: Thank you. I appreciate that.

Hypersonic defense. Well, I guess, let me just back up. I am disturbed by the fact that the President's budget proposes a cut at a time when we all know that we are facing a new threat and an important one. So perhaps what you are telling me is that there is money in other places to deal with a threat by things like directed energy. Is that correct?

Mr. Honey: Yes, Senator. That is correct. We do have funds elsewhere that are developing directed energy solutions for that particular threat.

Senator King: Okay. Well that is what I hope you can supply it for the record, as you suggested you would.

What have we learned from Ukraine? And I will direct this to any of the witnesses, but I would think the guys with the uniforms on might have some thoughts. General Karbler, what have we learned?

General Karbler: Sir, a couple of lessons that I have taken personally from Ukraine and that we are applying within the air and missile defense community. First, as I said in my opening statement, we see adversaries normalizing the use of ballistic missiles. If you went back about 10

years, force-on-force ballistic missile use just was not as prevalent, and now we see Russia, as well as other adversaries, using ballistic missiles.

Senator King: And conventional air defense does not work.

General Karbler: No, sir. You need ballistic missile defense in order to be able to counter that. And with that, we recognize also that it cannot just be an active defense solution. We have got to be able to integrate offensive capabilities to take out those missiles when we are on a tail or when aircraft is on a runway or in a hangar. So the offensive-defense integration is key, as well as then the layered missile defense. So everything from THAAD to Patriot to --

Senator King: Is it not true that most of the damage done in Ukraine has been done by artillery and missiles, not by conventional aircraft dropping bombs?

General Karbler: Yes, sir. And so that layered defense would allow us, you know, from Army capabilities, THAAD, and Patriot to counter ballistic missiles as well as cruise missiles and even our counter-rocket artillery and mortar, our C-RAM systems that we have to get after those particular artillery pieces.

Senator King: The question that I have gotten from a variety of people is why have we not provided the Ukrainians

with Iron Dome or something like Iron Dome?

General Karbler: Sir, the reason that we put a Patriot battery into Slovakia was because the Slovakians provided an S-300 system into Ukraine.

Senator King: And that is a rough equivalent?

General Karbler: It is a rough equivalent to Patriot. As far as the U.S. providing Iron Dome into Ukraine, you know, any involvement of any U.S. air defense forces in Ukraine would have to be a policy discussion.

Senator King: I understand.

General VanHerck, the Arctic. Give me 30 seconds on the importance of the Arctic in terms of this process. It seems to me that has opened up a whole new level of strategic competition.

General VanHerck: Senator, that is exactly right. So environmental change in the Arctic is creating opportunities and vulnerabilities -- access to resources that did not exist years ago, longer shipping seasons, economic prosperity. But what we are seeing is those norms and rules and international laws that have served us well since the end of World War II are under challenge, in the Arctic and elsewhere around the globe.

Senator King: Would it help if we ceded to UNCLOS?

General VanHerck: Senator, I support the succession to UNCLOS as soon as we can if we can make that happen.

Senator King: Thank you. Thank you very much, General. Senator Fischer.

Senator Fischer: Thank you, Mr. Chairman. Admiral Hill, I understand the Missile Defense Agency plans to deploy two satellites equipped with Hypersonic Ballistic Tracking Space Sensor. What is the Department's plan for this capability beyond these two prototypes?

Admiral Hill: Senator, thank you. Great question. Just to kind of go back, what Hypersonic Ballistic Tracking Space Sensor does, it is really two functions. The B stands for ballistic targets, and that handles some of the changes that we are seeing in the ballistic flights today, and kind of think of changes in propulsion, which challenge our sensors today. So we are going to meet that challenge with HBTSS.

But what it really does is it gives us fire control quality data on hyperglide vehicles, and when I say fire control I am not talking about putting out fires. What I am talking about is very discrete positional and velocity differences so that we can get a very firm track and put a weapon on it. So the weapons are very sensitive to having a very firm track, and we get that fire control data from HBTSS.

Now to your larger question of how does it fit into the broader architecture, we are very close with the Space

Force. They are working that architecture. It is not complete yet. What we will do in 2023, by having those first two in air -- they are built by two different companies. They will be interoperable. They are interoperable on the ground today -- we will track different flight tests that we do, and we will prove that we have that data so we have the confidence to then proliferate.

So we will work that closely with the Space Force over the next year to determine where they go. And there is flexibility in the sensor. It does not have to be limited to a LEO constellation. We can go with MEO. And so there is lots of flexibility, low-earth and medium-earth orbit. So we are working that with the Space Force and we will be part of that broader architecture. Thank you, ma'am.

Senator Fischer: And I know that there are other programs under development that are related to the missile warning and tracking, but are any of these other capabilities comparable in terms of being able to provide that fire control quality data that you need?

Admiral Hill: Ma'am, it really is unique to HBTSS for the hyperglides. So space capability is so important, not just because we are going to catch the global maneuver, but we use it for indications of warning. It is what kicks off an engagement today. General Karbler talked a little bit about that. When we see the flash then it will go through

the face of a radar, and that is how we get a track, if we can see the track on the ground. For hypersonics, since they are very hard to see, they will normally maneuver outside the field of view of a ground-based radar or a sea-based radar, so you would need that sort of constellation in place to get to the fire control data.

Now when I look at the capabilities that are in the architecture today they are very complementary. So the wide field of view, we kind of think of that as surveillance. So when we say "track" with a wide field of view that is going to contain those tracks, and then they cue the HBTSS to go and get that very fine precision track that we need to place a weapon on target.

Senator Fischer: How long do you think you are going to be collecting all this data on these prototypes before we are ever going to see any kind of plan for what the future is going to be, for what we are going to need in the future?

Admiral Hill: Yes, ma'am. If we get this right in terms of defining the architecture, and based on the data we have, we can make decisions as early as possible.

Senator Fischer: What does that mean, as early as possible? You know, I get really nervous when I hear dates like 2028 for something, and we are pleased that it is 2027.

Senator King: Eisenhower retook Europe in 11 months.

Senator Fischer: Shush. So how are we going to --

Admiral Hill: Do not think of it as --

Senator Fischer: -- condense the time period, and maybe have to accept more risk?

Admiral Hill: Perhaps, but I think right now we are not starting from zero. You know, in the storytelling of putting two up in March of 2023, there is work that is being done now in that architecture. So decisions can be made early for that proliferation and planning for that, and making sure that we have the industry lined up to execute.

Senator Fischer: At the hearing last year I asked about the status of implementing Section 1684 of the fiscal year 2017 NDAA, which requires the Department to designate a single entity as the lead acquisition organization for defending the homeland from cruise missiles. General VanHerck and Admiral Hill, you both made clear at the time your support for making this designation.

Dr. Plumb, welcome back again. When can we expect the Department to finally resolve this?

Mr. Plumb: Thank you, Senator Fischer. As you are probably aware, both the Secretary and the Deputy Secretary have committed to moving this forward. I am hesitant to give you a specific date but I think it is in the near future, and the Joint Staff is working on that, is my understanding.

Senator Fischer: I would just like to note another

thing I am worried about is lack of action. So it would be nice to see things move forward at a quicker pace.

Mr. Plumb: I am pushing on it.

Senator Fischer: Thank you. General VanHerck, in your funded priorities list it includes $50 million for cruise missile defense demonstration involving an elevated sensor. Can you describe that project and how it would contribute to pacing the growing cruise missile threat to the homeland?

General VanHerck: Senator, that is an opportunity to basically go all the way from the domain awareness sensor through a joint tactical fire control system -- Admiral Hill talked about that earlier -- to the actual execution and demonstration from a sea-based missile system to engage a cruise missile. It would help us reduce risk and move forward in the near term if we got that $50 million to demonstrate three separate engagements of capability.

Senator Fischer: Thank you. Thank you, Mr. Chairman.

Senator King: Senator Tuberville.

Senator Tuberville: Thank you very much. Thanks for being here.

I want to follow up a little bit on what Senator King was saying earlier. General Karbler, in my former job of coaching I used to watch teams on the field, on film. Sometimes you think a lot more of them, sometimes you think less, and then all of a sudden you get them in a real game

and you found out what they were.

Russia's missiles in the last 90 days, we have seen them in action. Can you give a coach's perspective and evaluation of what they have done, how they have done it? Has it been good, bad, indifferent?

General Karbler: Sir, I will give you a coach's perspective.

Senator Tuberville: Okay.

General Karbler: So the offensive line is not coordinated with the quarterback, who is not handing the ball off to the running back, and the wide receivers are jumping offsides.

So what do I mean by that? We have seen him employ his missile systems and artillery disconnected from any kind of ground maneuver. Anybody that understands combined armed maneuvers knows that you need to employ both in concert with each other to accomplish whatever your campaign objectives are, and we see him not doing that, which is, you know, whether it is the missile efficacy, whether it is the incompetence of the ground forces inability to move, logistics challenges, et cetera.

So from a coach's perspective, none. None of the players on the offensive have come together and moved the ball down the field.

Senator Tuberville: There are missiles that they have

launched, what percentage of them have worked? Do we have any idea?

General VanHerck: I can talk about that.

Senator Tuberville: Go ahead.

General VanHerck: Probably should not talk about it in an unclassified session, but I will tell you originally we thought they were not working at a rate that was as good as ours, but what I would say is they are on par with our capabilities. Not all of them, specifically their cruise missiles. They have had challenges with some of their hypersonic missiles as far as accuracy. But I would not take away, from a strategic perspective, that Russia's cruise missiles or hypersonic missiles, their strategic capabilities have severely underperformed, okay? I just want to make that clear.

Senator Tuberville: They make their own?

General VanHerck: My understanding is the internally, not the military makes them but they have companies, contractors within Russia that make them as well. You may know more, Jon.

Admiral Hill: Yes, sir. I think that explains it pretty well.

Senator Tuberville: Thank you. General VanHerck, you talked about the homeland. We have got a lot of work to do defending the homeland with hypersonics in China and

ballistic missiles. My understanding is that we have a majority of our F-22s and 35s in Alaska. Do we have a defense system up there that will protect them?

General VanHerck: Senator, it depends on what we are protecting them from. So I am confident in the ground-based interceptors that are there. So from ballistic missiles, yes, we do have that capability. With regards to cruise missiles, hypersonic cruise missiles that are actually currently coastal defense cruise missiles in Russia, I have significant concerns about my ability to defend those assets. Not only F-22s, Senator. You have significant portions of our ballistic missile and our threat warning capabilities in Alaska. Cobra Dane is out there at Eareckson Air Station. We have the radar and we are building our long-range discriminating radar as well. I was just there, by the way. Very impressive.

Senator Tuberville: Thank you. This is to anybody. You know, fixed interceptor sites, we are talking about trucking missiles in Guam, 42 trucks carrying missiles around. You know, that does not seem logical to me. The MDA is the lead architect and it looks like that we are going to have to find somebody to man and train them.

Can anybody talk about that, about Guam and the missile system that we are putting on Guam?

Admiral Hill: Yes, sir. I can give you some insight

there. First it was a pretty extensive Department-wide study. We did look at a number of fixed-site options, and then in the end, just given the kind of capability that we need on the island and the flexibility there we did go with mobile across the board. So the sensors will be mobile. The command and control, there is an option to be mobile. We are working that very closely with Admiral Aquilino now. And when it comes to the launching systems, those are mobile.

So I think the goodness that comes out of that is the investments that we make there, it is not a big engineering leap to get to that, and we have the existing Army mobile launchers. But the launchers that carry SM-3 and SM-6, the work that needs to be done to move those or have them in a mobile launcher is pretty straightforward, and so we think we can accomplish that. And it does give the combatant commander options on where he can move those downstream. So we will initially site them in an area and then if we need to move them we will move them.

Senator Tuberville: And we once had an Iron Dome in Guam. We do not anymore. Is that correct?

Admiral Hill: I will turn that over to General Karbler.

General Karbler: Sir, we exercised Iron Dome. We have two Iron Dome batteries. We sent one out to Guam to

exercise, to make sure it was deployable and that the soldiers could operate it. But Iron Dome is not our ultimate solution for cruise missile defense.

Senator Tuberville: Thank you. Thank you, Mr. Chairman.

Senator King: Senator Rounds.

Senator Rounds: Thank you, Mr. Chairman. Gentlemen, thank you all for your service to our country.

Dr. Plumb, it seems like this is the 11th or perhaps the 12th time that you have appeared before either the full committee or a subcommittee over the last few weeks, and it has been mainly concerning nuclear weapons and space. You are also the DoD principal cyber advisor, so I would like to ask you how challenging it is to serve as the OSD lead for space policy, nuclear weapons, countering the WMDs, missile defense, electromagnetic warfare, and cybersecurity, which are six significant roles. Do you have sufficient resources to execute your responsibilities?

Mr. Plumb: Thanks for that question, Senator. It is a sizeable portfolio. It is pretty fun, frankly. It is a good suite of strategic capabilities, and I think they marry up quite well. Space layers through all of them, cyber through all of them, and they are all what I would consider strategic layers to integrated deterrence.

As far as the resources needed, the office is far more

than just me. I have my DASD ships. I have the Office of the Principal Cyber Advisor.

But since you have given the opportunity here I will just say policy, in general, could use more manpower, or I guess I should just say civilians. We need more manpower resources. I think the growth in space, the growth in cyber, those two alone, and when you think that, for instance, the cyber offices are still basically staffed at the level they were 5, 6 years ago, that seems like the wrong answer.

Senator Rounds: Can you talk a little bit about the cybersecurity element of the both space and missile defense responsibilities and describe what you and your cybersecurity team bring to the table in this particular area.

Mr. Plumb: That is a very important question. Cybersecurity of our own forces I think sometimes is confused with just cybersecurity, for instance, of the SIPRNet or of JWST or even maybe the NIPRNet. But for the weapons systems themselves, absolutely essential. Making sure we take that into our space systems defense in-depth, is the thing I like to say at these hearings that is really important, not just a perimeter. I have had several discussions with Admiral Hill here on missile defense cybersecurity as well, and all of these things are an

ongoing issue that nothing is going to be solve overnight, and it is never going to be fully solved. You have to keep improving and keep looking for what the adversary could possibly do and figure out ways to keep that in check.

Senator Rounds: Yeah. A number of us on this committee have fought very hard to maintain key area of the DoD spectrum. As the lead for electromagnetic warfare can you tell this committee how important it is to be closely involved in the decision-making process when the Federal Government decides to conduct auctions for key DoD spectrum bands?

Mr. Plumb: Yeah, absolutely essential. Actually, my Ph.D. involved global positioning system, and so that specific issue which I think you are referencing is absolutely essential for DoD to be able to protect its ability to operate abroad.

Senator Rounds: So when one agency or department of the Federal Government arbitrarily decides to auction spectrum, it would appear that DoD should be directly involved in the discussions, specifically to those areas of sale. Fair enough to say?

Mr. Plumb: I agree, sir.

Senator Rounds: Thank you. Admiral Hill, the United States has consistently provided missile defense capabilities in conjunction with Israel. It has been a good

partnership both ways. Can you explain to this committee the importance of our relationship with Israel, specifically when it comes to missile defense for the United States and our allies and partners?

Admiral Hill: Yes, sir, Senator. Thanks for that question. We have a very strong partnership, documented in an MOU, and you that half a billion dollars of the MDA budget goes to Israel. We work the full set of layered defense with Israel, from Iron Dome up to David's Sling up to the variants of Arrow to include their latest elevated sensor, the work that they do connecting all those and the networking of that. We also work with them on their target systems, and we sit side-by-side and help them engineer through what they need to do to execute a test.

Senator Rounds: Is it fair enough to say it is a good partnership with information flowing both ways?

Admiral Hill: It is a strong partnership, and I would say it is beyond what you would normally see because we are side-by-side. So there is not just the flow of information and the learning, there is definitely, you know, our people that just walk away from that having a better sense of tiered, layered defense in a really constrained area, with very short reaction times.

Senator Rounds: Thank you. I am about out of time but I am going to try to get in one more question, and this is

for General Karbler. You mentioned relocating two Patriot batteries to Poland in March. It was a necessary move, in our opinion, and I think you did the right thing. The question I have is how much more flexibility do you have to relocate missile defense capabilities when needed, what flexibilities should you have, and what is the state of the industrial base should we need to surge missile defense capabilities?

General Karbler: Yes, Senator. So the Army Air Missile Defense Forces are the highest operational tempo of any Army forces that we have, so any deployment of them does stress the force. So we are constantly looking at our air missile defense posture globally. We have battalions out in INDOPACOM, we have got the battalion in Germany, and then we have got battalions that support CENTCOM.

So it does stress the force, and in talking with the Chief of Staff of the Army about this just last week he understands it, and the Secretary of the Army as well. They have committed to a 16 Patriot battalion as well as an 8 THAAD battery and 4 additional maneuver SHORAD battalions. So we are growing the Air Defense Force in recognition of the optempo stress that is put on our soldiers.

Senator, with respect to the industrial base capability, I would really have to defer that to the PEO Missiles and Space, the acquisition side. But I would tell

you from my experience if I went back to Desert Storm, when we had very, very few Patriot interceptors to do ballistic missile defense, and the industry ramped up very quickly and was able to get those Patriot interceptors out to the Patriot -- I was in Israel -- to the Patriot units in Israel as well as the Patriot units that were in Saudi Arabia.

Senator Rounds: Thank you. Thank you, Mr. Chairman.

Senator King: Thank you. We will have a second round of questions for those who have additional questions.

I think it was Admiral Hill, you used the term "fire control data" with regard to hypersonics. I wrote in my notes "fire what?" What are we firing? As you know, we have talked about this, I am gravely concerned about the strategic change in the whole scene of battle that hypersonics represent. And I know we are working on it and we are talking about. I want a sense of urgency.

Tell me, Admiral, if you are the commander of an aircraft carrier 800 miles from China and they send a hypersonic missile your way, you have got about 9 minutes to figure out what to do. I want to know how close we are to having a defense. And I guess the second question is, is North Korea developing hypersonic capability, because if they are that is where we need to be focusing, not on hitting a bullet with a bullet over the North Pole.

Admiral Hill: Yes, sir, Senator. Thanks for that

question. We often talk about hypersonics and assume we are at zero. We are not at zero. I mentioned earlier that we have a command and control battle management capability that takes the space sensors that we have today, the land-based sensors and the sea-based sensors. And what is really key about sea-based is that is where the defensive capability resides today.

So when a carrier strike group goes forward, to use your example, they have some number of destroyers with them, and on those destroyers today the sea-based terminal capability is on those ships. We did that based on a request from the CNO, because he was concerned about the carrier-killer missile. You have heard plenty about that in the white press. It looks ballistic, so we have an ability with SM-3 in the upper tier to take out that threat, and then we have, in the lower tier, sea-based terminal which is really a capability that we insert into the SM-6 missile that the Navy produces. So the Navy is producing those in number. MDA is providing the software package and the work in the combat system to control that missile. So we have the capability to take on the advanced maneuvering threat in terminal.

I will say terminal is not sufficient. As I mentioned earlier, it is the most difficult place to engage -- high maneuver, high speed, and again, you do not know where a

terminal is. Generally, in the sea base, it is going to be after the carrier so the destroyers will operate in close quarters and ensure that they provide that protection.

Now because it is not good enough, the investments we are making in the President's budget 2023 is towards the glide-phase interceptor. So when you think about having a layered defense against the glide vehicle that then dips down and comes in and does the maneuver, we have the ability to stop that at the glide phase. The most vulnerable place --

Senator King: We want the ability. You said we have the ability.

Admiral Hill: We have three contractors in play right now to deliver that capability. We are moving towards a demo over the next few years. So we will down-select this year to two and we will continue to move through, and then we will deliver that demo, conduct an exercise with that.

Senator King: Is North Korea developing hypersonics?

Admiral Hill: They claim to have developed hypersonics. If you go look at the outer mold line you might be fooled and think that it is. But in terms of what we have seen, in terms of data, I am entirely confident that they have that capability today. But the fact that they are testing it ought to be of concern.

Senator King: Director Honey, you mentioned directed

energy in your testimony, I believe. That strikes me as a promising -- and I know there are technical problems, but give me an update on where we are in developing directed energy, microwave or laser.

Mr. Honey: Both classes of directed energy systems, lasers and high-power microwaves, have seen significant developments and achievements over the past several years. And what I am most impressed with is the fact that we now have high-energy laser systems, 130-kilowatt class systems, that are being deployed on ships for operational testing, and we have a modular package that will be able to be deployed on Army ground vehicles as well as ships. These will be going into, as I said, operational testing around the world this coming year, and out of that we will be able to gain tremendous insights on lethality data to see how those systems will be useful in the future.

They are mainly aimed at dazzling as well as cruise missile defense, and we also have significant developments in higher-power system and lasers that we think will be very important in the upcoming few years.

Senator King: Do you have sufficient resources to accelerate this process?

Mr. Honey: Yes. We have sufficient resources and also the folks leading the efforts have much better insights today than they did in the past. And just through

understanding where to smartly take risks they have been able to accelerate development significantly.

Senator King: Admiral, if you were the commander of that aircraft carrier I would want this guy to be supplying you with some weapons.

Admiral Hill: Thank you, sir. I would want everything that is available, and will take the power that you have now and put it on the ships if we could.

Senator King: Thank you. Senator Fischer.

Senator Fischer: Admiral Hill, it is my understand that the Department intends to award a production contract for 20 Next-Generation Interceptor rounds following the critical design review, and these interceptors will be deployed to the unoccupied silos at Fort Greely. But what is the plan to modernize the current fleet of 44 ground-based interceptors?

Admiral Hill: Yes, ma'am. Thanks for the question. I think the best way to answer it is to just kind of clarify that we have about three classes of the ground-based interceptors that are in service today. You have the oldest part of the fleet, you have got the midgrade fleet, and you have got the newest ones. So I know that General VanHerck takes that into account when he is working his shot doctrine.

So we are not real concerned about the new ones. They

have a long life and their reliability will carry them into the 2030s. Our plan is to reach a decision in production around the 2024 time frame. When you get to the preliminary design review and start thinking about production there are options there because we do have the missile field that is ready to take those first 20. We will likely make a decision to fill those first 20, but the nation has the option to start replacing some of the older ones. And that is why I think it is very important to have the two contractors in play.

That is the other option we have here. You can keep them beyond the CDR and you can have a double production house, depending on where the threat goes, and if you need numbers we can build the numbers by having two contractors carry through critical design review.

Senator Fischer: You said you are likely to have a decision made soon. When would you expect that?

Admiral Hill: Yes, ma'am. I could not remember where the actual place on the chart was but it is in 2024 where we will make a production decision. And part of that discussion would be are you going to fill the missile fields or are you going to replace what you have or are you just going to keep building so that you can fully replace the existing inventory. Those are decisions that we have to make within the Department.

Senator Fischer: And are you comfortable with that?

Admiral Hill: I am comfortable that we have two contractors in play and that those options will be there to build out, fill that missile field, and then replace if we make a decision to do so.

Senator Fischer: Is this something that you are discussing with NGI teams?

Admiral Hill: Yes, ma'am, absolutely. And I mentioned a little bit earlier, actually General VanHerck mentioned the 2028 time frame for the contractors, and we are moving ahead of that schedule right now. We are going to learn a lot more as we come through development. We will come through ground testing. We will do individual component-level tests, and we will work our way to flight tests. This is a fly-it-before-you-buy-it program, so we are going to do an intercept and salvo test before we go to full production.

Senator Fischer: General VanHerck, given what you have seen of the threat that is out there do you believe that 20 interceptors are going to be sufficient, or do you need some sort of capability to replace the 44 GBIs that are deployed currently?

General VanHerck: Senator my assessment is when you factor in service life extension, which will give us significant reliability and data and information that will help me with my shot doctrine, and give me additional

capacity, when you factor in the Next-Generation Interceptor and its capabilities, along with long-range discriminating radar, all of that, I will be comfortable when it is delivered in the 2027 to 2028 time frame.

It is a policy question going forward. Do we need to continue to develop and field additional capability and capacity as the threat develops additional capability and capacity? I remain concerned about my ability to stay up with that capacity especially.

Senator Fischer: Thank you. Admiral Hill, the general just, I think, made an argument there against some of what we hear sometimes that we do not need to replace systems, that we just need to continue to do life extension programs. And I know that seems to be the current plan, likely to be the plan for the future. But how long do you think that can continue? Do you have the same concerns that the general expressed?

Admiral Hill: I do. We read the same intelligence estimates, and they are always, you know, low confidence, medium confidence. But you can kind of get a sense, based on their testing and how they have progressed over the years.

I would say there is a big difference between the GBIs that we have in service today versus what Next-Generation Interceptor brings. And in this unclassified environment I

will tell you that a unitary missile, think of that as a singular kill vehicle, versus a Next-Generation Interceptor with multiple kill vehicles on it, that is a huge lift in terms of how we take on the threat, because the threat will continue to evolve to have maneuvering warheads and multiple maneuvering warheads.

So we need to the Next-Generation Interceptor. We can SLEP all day long those unitary missiles, and we can drive their lifetime to the right pretty far. But at the end of the day, you really need the upgrade that Next-Generation Interceptor brings because it is going to operate in a really tough space, but it does have multiple kill vehicles, which gives us a lot more flexibility.

Senator Fischer: And we have to have the resources that meet the threats that are coming too, that we get from intelligence. Correct?

Admiral Hill: Yes, ma'am.

Senator Fischer: Thank you.

Senator King: Senator Tuberville, are you all set?

Senator Tuberville: I have one question. Thank you. Secretary Honey, you talked about high-energy lasers. I have had the unfortunate -- I have watched one work on the ground, from an MRAP low-energy. It was not really high-energy but it works pretty good.

Eventually, you know, you said putting them on ships

and possibly in satellites. How in the world are we going to find the energy for a high-energy laser, you know, to really function the way we really want it? Are we on the R&D -- how is the R&D on that, as we speak?

Mr. Honey: The R&D has come a long way, and that is a very good question about these particular systems because of the history behind them. Where we have seen the biggest improvements has been in the conversion efficiency of energy to actual useful output from the lasers as well as improvements in the beam control so that we do not have to have such a massive blast in order to have the weapons effects that we want.

There has been just a tremendous amount of work that has been done by the Department in these areas, but we are now seeing the payoff of those results today.

Senator Tuberville: Do you see nuclear being used, energy?

Mr. Honey: I am sorry?

Senator Tuberville: Nuclear, to power higher energy, possibly?

Mr. Honey: No, I do not see that right now as necessary. There could be, you know, always the possibility.

Senator Tuberville: I am talking about for the future. You know, we are talking about Star Trek and all of that,

you know, satellites that have these long beams.

Mr. Honey: Right now, at least for the systems that we are looking at, the conventional power sources that we have look to be sufficient.

Senator Tuberville: Thank you. Thank you, Mr. Chairman.

Senator King: Senator Rounds.

Senator Rounds: Thank you, Mr. Chairman. I am going to follow up on Senator Tuberville's line of questioning, because it seems to me that where we are talking here about what a lot of people that would watch this would say they are talking about something really close to Star Wars or Star Trek in terms of basically shooting one missile with another missile, hitting one missile that is capable of 5,000-plus miles an hour with another missile or an interceptor that can do the same thing, or using a weapon of directed energy, like a phaser or a laser in the future.

We are talking about that right now being deployed in some specific areas today, and yet, at the same time, I think back. I just received a note that General VanHerck, your team has actually been looking at cold weather and the fact that you have got teams that have to survive in cold weather, and we have got Arctic issues and so forth. We need the basic research. I know South Dakota School of Mines and Technology has been doing work on cold weather

operations and so forth. And I look at that and we have got a part of the world right now that is going to become very active in terms of protecting our country, and that is the Arctic.

I am just curious, General VanHerck. What do you see in terms of the challenges of operating in the Arctic, and what are the things that we are not thinking about right now that we have just assumed we have been doing all along, and yet we have got equipment, we have got material, manpower, and so forth? What do we have to expect that we should be doing right now to make sure that within the Arctic we have done our due diligence and we have not taken anything for granted in terms of being able to operate?

General VanHerck: That is a great question, Senator. We just completed an exercise in the Arctic, Arctic Edge, where we brought joint, and even combined with other countries to the Arctic to operate. I will tell you, there are significant lessons learned about the harsh environment where our equipment -- I will not go into details but let us just say some strategic equipment that we place into the Arctic does not function because we have not equipped it to operate, and over the last 20 years we have been focused on a different environment as we developed equipment.

So research and development is crucial to continuing to ensure we buy down risk to potential future operations in

the Arctic. It does not just go to weapon system as well. It goes to human performance factors -- medical capabilities, medical equipment, as you sustain yourself in a harsh environment like that long term. We have to look at the equipment we wear and the capabilities that we are going to utilize to sustain life in that environment.

What we find is that you can operate in that environment less than about 50 percent of what you would in another environment. So I appreciate what your School of Mines is doing, advancing a lot of the research and capabilities to look at that. That is something I am asking for in our Defense Planning Guidance is to at least move the ball down the field and continue that research and development for ensuring the capabilities are there but also capabilities that support the human life as we sustain in the Arctic environment.

Senator Rounds: Thank you, sir. Thank you, Mr. Chairman.

Senator King: To follow up on your question, Senator Rounds, I recently learned that two-thirds of the ice in the Arctic Ocean has disappeared in the last 40 years. A stunning fact.

I want to ask one more question.

Senator Rounds: And if I may say, if I could, and yet at the same time you have a problem in that unless you have

got the right kind of oil you are not going to operate very well in the Arctic conditions anyway because your machinery does not work.

Senator King: Because it freezes.

Senator Rounds: Just because it freezes.

Senator King: I would say Maine and South Dakota rather than Alabama might be able to work on that.

Senator Rounds: That has a lot to do with it, Mr. Chairman.

Senator King: A question from Senator Hirono. General VanHerck, for fiscal year 2023 the Administration has not funded the development of the long-range radar in Hawaii to detect incoming threats from North Korea or China. Do our current radar and ground-based interceptors provide adequate protection of Hawaii?

General VanHerck: Senator, I am comfortable with my capability to defend Hawaii against ballistic missiles from a rogue actor such as North Korea today. As capabilities continue to develop, as capacity increases by potential rogue actors, then I may be potentially challenged to defend Hawaii. What we are really talking about is a Hawaii radar would contribute to an underlayer significant that would give additional capability and capacity. That is a policy decision that we go down there, but today I am comfortable where we are.

Senator King: Thank you. Thank you all very much for your responses today, for your testimony, and for your service. It has been a very illuminating hearing. I appreciate you joining us.

The hearing is adjourned.

[Whereupon, at 5:38 p.m., the subcommittee was adjourned.]